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A GUIDE TO CENSUSING PINNIPEDS IN THE CHANNEL ISLANDS NATIONAL MARINE SANCTUARY AND CHANNEL ISLANDS NATIONAL PARK

by

Douglas P. DeMaster, Robert L. DeLong,
Brent S. Stewart, Pamela K. Yochem,
and George A. Antonelis

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A GUIDE TO CENSUSING PINNIPEDS IN THE CHANNEL ISLANDS
NATIONAL MARINE SANCTUARY AND CHANNEL ISLANDS NATIONAL PARK

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CONTENTS

	Page
INTRODUCTION.....	1
MONITORING CHOICES.....	2
CURRENTLY AVAILABLE TECHNIQUES.....	2
RECOMMENDED PROCEDURE TO MONITOR PINNIPEDS.....	5
ACKNOWLEDGEMENTS.....	9
LITERATURE CITED.....	10
APPENDIX I. Summary of BLM codes used in pinniped censuses within the Channel Islands National Park by Douglas DeMaster and Laura Wing.....	16

LIST OF TABLES

Table	Page
1. Summary of techniques and their requirements.....	11
2. Schedule of counts made to monitor pinnipeds in the Channel Islands National Marine Sanctuary.....	12
3. CINMS Pinniped Census Form.....	13
4. Distribution of pinnipeds by beach within the sanctuary. Asterisks indicate pupping occurs on that beach. Data are from 1975-1982 (Bonnell et al. 1980 and Stewart 1981, 1982).....	14

LIST OF FIGURES

Figure	PAGE
1. Pinniped census data form.....	15

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INTRODUCTION

To better protect the pinnipeds in the Channel Islands National Marine Sanctuary and National Park, resource managers have determined that it is necessary to monitor the population dynamics of pinnipeds throughout the five islands encompassed by the Sanctuary. This report documents what is currently considered by the authors to be the best combination of techniques to monitor pinnipeds within the Sanctuary.

The purpose of this document is to familiarize Sanctuary Program Division (SPD) and National Park Service (NPS) personnel with techniques that are currently available to census pinnipeds, and to recommend which techniques are best suited to the requirements of the NPS and SPD. In addition, a standardized code to use in recording all positions is provided in Appendix I.

The California Channel Islands and surrounding waters support a larger and more varied population of seals and sea lions than any other area in the world that is immediately accessible from major centers of human population. These marine mammals represent a major scientific resource and a significant recreational attraction. Species belonging to six genera of pinnipeds (seals and sea lions) of two different families occur on these islands. Breeding here are the California sea lion (Zalophus californianus), the northern fur seal (Callorhinus ursinus), the harbor seal (Phoca vitulina), and the northern elephant seal (Mirounga angustirostris). The Guadalupe fur seal (Arctocephalus townsendi), and the northern (Steller) sea lion (Eumetopias jubatus) are known to use these islands as hauling sites.

The primary reason to census pinnipeds systematically is to document long term changes in the distribution and abundance of each species. These changes may be caused by changes in food supply, disease, disturbances to hauling sites by recreational users of the Sanctuary, entanglement of seals in fishing gear, or changes in hauling habitat due to weathering processes. In addition, oil pollution, pesticides and heavy metals contamination are known to adversely affect pinnipeds. Ideally, it will be possible to correlate changes in distribution/abundance of pinnipeds with one of the factors mentioned above. However, this is only possible if a series of counts exists to elucidate the natural variability in the system.

Management responsibility for the pinniped populations of the Channel Islands is shared among a number of federal agencies: The National Marine Fisheries Service, the National Park Service, and the National Marine Sanctuary Program. The individual responsibilities of each agency are specified in the Marine Mammal Protection Act of 1972, the Magnusen Fisheries Conservation Management Act of 1976, Public Law 96-199, and the Marine

Protection, Research and Sanctuaries Act of 1972. In addition, the State of California is concerned about the management of pinnipeds in California and may request management authority, as described in recent amendements to the MMPA. The mandate for pinniped management in the Sanctuary and Park is complex and should include sound management of pinniped prey species, regulation of access to areas critical to feeding and breeding, monitoring of marine mammal/fishery interactions, and coordination with agencies responsible for mineral development.

MONITORING CHOICES

Two basic types of indexes are used to monitor changes in populations of wildlife. They are: 1) indexes that track the size of the population, and 2) indexes that track the "condition" of an average individual in the population (Hanks 1981). Population indexes characterize changes in population size independent of environmental or habitat condition. Population indexes that are commonly used in pinniped management include counts of pups, counts of hauled animals, and mark/recapture estimates of an entire population (Eberhardt 1978). Condition indexes track how the average condition of an animal in a population changes over time. Therefore, these indexes may change when the population level is constant, but habitat conditions vary. Commonly used condition indexes in pinniped management include: the average age of sexual maturity, the average age of the population, length to girth ratios, rates of agonistic encounters, food habits, and time spent feeding. Other condition indexes are described in Eberhardt and Siniff (1977).

Prudent management of wildlife resources requires that both types of indexes are used (DeMaster, 1984). When used in combination, it is possible to discriminate between a population that is declining because of a reduction in habitat quality versus a reduction caused by high levels of incidental take. It is also possible to predict whether a population is likely to decline, increase or remain constant. Without this dual-index approach, it is not possible to understand changes in population size, and tailor prudent management responses.

This report describes techniques used to monitor changes in population size (population indexes). However, without information on vital rates, food habits, and behavior, it is not possible to determine causes of changes observed in population levels. Therefore, a sound resource management program should include the monitoring techniques described in this report, as well as research designed to monitor the condition of animals in the population.

CURRENTLY AVAILABLE TECHNIQUES

Three types of techniques are currently used to index the population levels of pinnipeds in the southern California Bight (SCB): ground counts at rookeries; aerial counts, where counts of animals are made from 35 mm transparencies (photos are usually taken at an altitude of 150-300m and at an oblique angle); and aerial counts where counts of animals are made from 9 inch transparencies (photos are usually taken from 150-300m and at a vertical

angle). A comparison of these techniques is provided in Table 1.

Ground Counts

Ground counts are generally considered to be the most accurate technique for counting pups in large rookeries in southern California. Other techniques usually underestimate the number of pups present. Ground counts also provide an opportunity to collect information on condition indexes, such as food habits, tag resights, and weight at weaning. If the rookery is easily accessible, ground counts are usually the least expensive of the three techniques. The major disadvantage of ground counts is the amount of disturbance, which can, if frequent enough, lead to changes in the distribution of animals. Counts, therefore, must be made with minimal disturbance. Ground counts are used only to census pup production in otariid and elephant seal breeding colonies. Counts are made after all pups have been born and when most pups are congregated into large groups. Counts are made before pups begin to swim. It is also desirable to schedule counts after most breeding activity has been completed, because most of the breeding females and males have returned to the sea to feed. More details will be given in the methodology section.

Aerial Counts (35 mm photographs)

Aerial counts from oblique photography made from 35 mm transparencies are ideal for monitoring the distribution of rookeries and hauling sites within the Sanctuary. This technique is used to enumerate pinnipeds when they are relatively dispersed or to obtain a qualitative description of the distribution of rookeries. For example, this procedure is effectively used to census sea lions outside of the breeding rookeries and harbor seals throughout the Sanctuary. Coverage is relatively inexpensive (an entire census can be contracted for about \$3,000). Use of experienced observers is critical to obtain precise estimates with this technique. Inexperienced observers should only be used as recorders initially. Flights are usually made in twin engine, high-wing aircraft with three people: pilot, photographer, and recorder. A high quality 35 mm camera with a 200 mm and a 43-80 mm zoom lens, and a motor drive, is used. Film speed is 200 or 400 ASA. One major advantage of this technique is that all of the Sanctuary islands can be censused in about four hours, reducing the probability of double counting animals on consecutive days. However, a number of problems should be recognized. One, it is very difficult to enumerate pups from photographs because pups can easily blend in with the background. Pups will generally be missed, unless light conditions are ideal and animals are dry. Secondly, animals in dense concentrations are also very difficult to accurately enumerate. Finally, if a hauling site is disturbed just before the overflight, animals will not be available to photograph. Therefore, flights must be timed when vessel traffic and human use of beaches are at a minimum. In addition, peak haulout of many species will vary by time of day and season, and this must be considered when planning surveys. For these reasons, it is often advisable to replicate aerial surveys to get more precise estimates.

Aerial Counts (9 inch photographs)

Aerial counts, using 9 inch transparencies, have not previously been used to count pinnipeds in the Sanctuary. The technique is in a developmental stage. Photographs are taken with a high resolution, RC-10 camera at an altitude of 250-300m. Images at this altitude cover an area approximately 500m by 500m. A survey altitude of 250m appears to be the best for photo interpretation. Photographs are taken vertically whenever possible. This allows extremely accurate interpretation of photos as far as species and age composition because stereoscopic viewers can be used, and animals can be measured on the same scale throughout the image. Problems with this technique include: the necessity to define all areas of hauling in advance and the cost of photographing these areas whether seals are there or not; the relatively high cost per frame (\$20 per frame) and the high cost of interpretation (it takes roughly 30 minutes for a trained observer to count one image of a dense seal colony).

As with aerial surveys involving 35mm photography, daily and seasonal hauling patterns and effects of disturbance must be taken into account with timing overflights. However, this technique offers a permanent record, allows an estimate of animal length to be taken directly from the image, and allows for an analysis of spatial distribution, which oblique, 35mm imagery does not offer. This technique may be best suited for monitoring Santa Barbara Island, which is a small rocky island, that is difficult to ground count. It may also prove very useful on sandy beaches, like Pt. Bennett, where the contrast between animal and substrate is great. Final evaluation of this technique is currently underway by comparing ground counts and aerial counts from San Miguel and Santa Barbara Island for sea lions and elephant seals.

RECOMMENDED PROCEDURES TO MONITOR PINNIPEDS

Timing of Censuses

A schedule of censuses and recommended pinniped censusing techniques for use in the Sanctuary is given in Table 2. Essentially all of the sea lion and elephant seal pupping in the Sanctuary takes place on San Miguel Island. Santa Barbara is a relatively small rookery. However, trends in pup production and any changes in the current distribution of pupping beaches need to be monitored. Historically, northern sea lions (and possibly California sea lions) pupped at Santa Cruz and Santa Rosa Islands, and these beaches should be carefully examined during the breeding season for signs of recolonization.

All census data should be recorded so that it can be easily transcribed to the "CIMS Pinniped Census Form" (Table 3 lists data requirements). Use of these "prompted" data entry forms will help ensure that data are collected consistently from year to year.

In addition, permits should be applied for in advance from the National Marine Fisheries Service. Both aerial and ground surveys require a permit to authorize a take by disturbance, under the Marine Mammal Protection Act. Applications can take up to 120 days to process.

Censusing California Sea Lions:

Premature births at San Miguel Island

A ground survey of all hauling areas on Point Bennett is made in late April and mid-May to document the number of premature births. Two to three biologists survey all hauling areas on foot and record the number of premature sea lion pup carcasses. The biologists should work independently. Carcasses are marked with red surveyors tape and deposited in groups of 10 to 20 in single locations in each general area to avoid recounting in later surveys in May or to avoid counting as full term neonatal mortalities in late July. The numbers of premature pups counted by each biologist are summed for each general area and later for all of Point Bennett. A thorough survey requires seven to eight hours to complete.

Pup Production

Sea lion hauling and breeding areas in the Point Bennett area are surveyed in late July to early August to document peak pup abundance. Most pups are born by 20 June and the majority of these remain on the rookery through early August. Breeding occurs from about 20 June to 20 July and by late July female abundance declines as an increasing number of parous females lengthen their feeding trips at sea. Following the breeding season, many

adult males return to sea. Therefore, most pups are still present on the rookery in late July and many of the post reproductive females and males are at sea. At this time, most pups are old enough to tolerate a separation from the cow. In mid-late July the census is taken and is conducted on sunny days with little or no wind to minimize the effects of disturbance and separation of pups from their mothers. The censuses are begun late in the morning when most animals have moved from the interior hauling grounds to or just above the splash zone. A team of two or four biologists, experienced in censusing pups, walks slowly, well above the beach crest to "ease" the adults into the water but yet far enough from the pups so that they do not panic and are moving about very little. Subsections are then selected by the team and pups in that subsection are enumerated by each biologist. The counts for each subsection are compared and accepted only if they are within 10% of the mean count. If not, enumeration for the subsection is repeated. Each biologist's counts are summed over subsections. Pup production is estimated as the average of all of the total counts for the team. The variation among the biologists' counts for each area is analyzed independently.

Sea lion pups at Santa Barbara Island (SBI) are counted during ground surveys. Ground counts at SBI are conducted in late July/early August similar to the Point Bennett ground counts. Ground counts are difficult at Santa Barbara and should be conducted carefully to minimize disturbance. A single, experienced observer can move slowly above the rookeries to make counts with a minimum of disturbance. Gulls will disturb the sea lions, so observers must minimize disturbance to gulls as well.

Aerial surveys, using a 9" format, are made in the last two weeks of July at San Miguel and Santa Barbara islands. Flights should be made at mid-day with a relatively low tide. Ideally, some cloud cover should be present to reduce glare from the sun, but still provide good water penetration to allow any animals in tide pools to be counted. Photographs should cover Pt. Bennett, Castle Rock, Richardson Rock, Judith Rock, and all of Santa Barbara Island.

Hauled Animals Outside Breeding Rookeries

Surveys are conducted by aircraft, and counts are made from 35mm color photographs. Surveys are flown during selected times (Table 2), and all hauled seals should be photographed except at Point Bennett and Santa Barbara during July and February. Special attention should be given to historically used hauling sites and nearby beaches. Counts made during the breeding season are used to document changes in the distribution of rookeries. Counts made outside of the breeding season are used to monitor any changes in the distribution of hauling that may be associated with seasonal hauling patterns, vessel traffic, and beach disturbances. During all surveys, dead or beached cetaceans should be reported to the Southwest Regional Office, NMFS (attention: S. Stone).

Censusing Northern Fur Seals

Northern fur seals occur only at Adams Cove, San Miguel Island, and Castle Rock in the Sanctuary. Pupping generally begins in late May and is completed by mid-July. The mean date of birth is June 26. Pup production and mortality are monitored daily from observation blinds along the bluffs overlooking Adams Cove with binoculars or 15-60x telescopes throughout the breeding season. Disturbance is minimal in this type of procedure. Counts of pups at Castle Rock are conducted during the last week in July using the same techniques described above for California sea lion pup counts at Point Bennett.

Censusing Northern Elephant Seals

A ground count of elephant seal pups is made in the last week of February on San Miguel (SMI) and Santa Barbara islands. Most of the cows have left by this date. At SMI, pups will be in large concentrations inland of the beach crest, as well as in isolated groups in the arroyos of Pt. Bennett. In addition, cows and pups will be scattered along the entire south side of SMI. At Point Bennett, counts are made by two observers. Discrete areas of the beach are marked in the sand, and counts of all elephant seal pups are made within a subsection by both observers. Subsections are about 20 m to 40 m wide and no more than 100 m long. If counts are not within 10% of each other, additional counts are made until agreement is reached. The entire Point can be counted in about 6 hours by experienced observers. Other beaches are surveyed on foot the following day by one or two observers. Counts at each beach are tallied separately. An aerial survey (9" format) is made at the same time as the ground count at San Miguel; only Pt. Bennett is photographed.

At Santa Barbara Island, pups can be counted by ground observers from the cliffs above the rookeries with 7-10x binoculars. This survey takes about 3 hours. Aerial surveys of elephant seal pups are also made. All of Santa Barbara Island can be covered with roughly 20 images using a 9" camera at 750 ft.

Censusing Harbor Seals

For Pacific harbor seals, the entire cohort of pups is never hauled out simultaneously. This is because the period of pupping extends over a two month period, while the weaning period is less than one month after parturition. The proportion of the total population that is hauled out will vary by time of day, area, tides, weather, and season. The most consistent and highest proportion of the total population will haul out in early afternoon during the molt period (late May/early June in the Sanctuary). Therefore, counts of harbor seals should be made at mid-day during the molt period.

Neither pup counts nor counts of hauled animals provide a good estimate of the total population. However, if counts are made annually at a consistent

time of year using the same techniques, the data can be used to monitor changes in distribution and relative abundance of harbor seals. This information should be sufficient to manage harbor seals within the Sanctuary.

Harbor seal surveys should be made while flying at altitudes of 150-300 meters and 50-100 meters offshore in a high wing, twin engine airplane. Seals at all hauling sites are photographed with a 35 mm camera equipped with a motor drive and 200 mm zoom lens. High speed slide film (200ASA or 400ASA) should be used to photograph hauled out seals. The survey team consists of a pilot, observer/photographer and an assistant who serves as observer and data recorder. Harbor seal haul out areas are recorded on standard maps for each island. Voice recordings of the flights are made using portable cassette recorders. Counts of harbor seals are obtained by projecting processed slides on a large viewing screen and scoring each area for total numbers of seals and numbers of pups present.

Censusing Guadalupe fur seals and northern sea lions

These two species have been seen hauled out only in the Pt. Bennett area and at Castle Rock (San Miguel Island) in recent years (1980 to present). Fewer than three Guadalupe fur seals and six northern sea lions have been counted at any one time since 1981. Although two northern sea lion pups at San Miguel Island (Castle Rock) were reported in 1981, there have been no pups reported for either species since 1982. Castle Rock is difficult to census and only experienced research personnel should survey Castle Rock for either species. To document the presence of adults and pups of both species, the areas where they have been reported (Table 4) should be checked from early June to late July.

DATA ANALYSIS

Counts

Total counts of all seals and pups should be analyzed in two ways. First, a qualitative comparison of beach use for both pupping and hauling out for all six species should be made from year to year. Changes in haul out patterns can reflect changes in population levels or changes in the level of disturbance around areas critical to breeding and feeding. A second analysis involves a quantitative comparison of the population index of choice for each species. Counts are presented by year and by island. A regression of log-transformed counts against time can be fitted to a straight line to determine the rate of growth. A significantly positive slope implies the population is increasing. A negative slope implies the population is decreasing. A nonsignificant slope infers that there is no consistent change in population size. Additional information can be gained by looking at the pattern in the residuals or fitting a second degree polynomial to the data set (see DeMaster et al. 1982).

Report generating system

A report generating system has been developed at the Southwest Fisheries Center to facilitate rapid presentation of survey data (Berkson 1984) collected in a specified form (Figure 1). The system invokes an interactive, user friendly program to manipulate information from specified surveys. The "computer" prompts the user to specify types of information desired and then requests the user to designate an output format. Plots or tables can be generated for counts by age/sex class, by species, by island, by year, and by month. In addition, plots or tables of the percentage of a particular age/sex class of a species relative to the total number of animals seen can be generated.

ACKNOWLEDGEMENTS

The techniques described in this paper have evolved over many years and because of many people. They should all be congratulated. Special thanks for comments from Gary Davis, Carol Pillsbury, John Epting, William Ehorn, Nicholas Whelan, Reed McKlusky, Jim Lecky, and Dana Seagars. Future biologists will no doubt want to improve on these techniques, but we acknowledge their tolerance in also conducting these types of counts in an effort to be consistent over what seems like an eternity, but is probably no more than 10 years. Dr. Gary Sakagawa added many useful comments to an earlier draft of this manuscript.

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Table 1. Summary of techniques and their requirements.

<u>Techniques</u>	<u>Requirements/Specs</u>	<u>Comments</u>
1. Ground counts	- min. 2 people - Clicker counters - binoculars - spotting scope	- disturbance can be a problem - information on tags, ages, food habits, etc. - least biased - demands most effort
2. Aerial 35mm	- Beach Travelair/ Cessna skymaster/ or similar aircraft - altitude - 150-300m - 50-100 meters offshore - 35mm camera w/motor-drive and 200mm, and zoom 200m lens - high speed (400 ASA) color film - slides viewed on dissecting scope	- usually under-estimated pups - good for distribution - best done in replicate - permanent record made - fly during peak haulout
3. Aerial, 9"	- contract with experienced photogram-metric firm - experienced person to interpret imagery - altitude: 750-1000 ft - directly over hauled pinnipeds - pre-survey determination of transects	- \$20.00 per frame plus airtime - Pt. Bennett taken roughly 15 frames - interpretation takes 30 min. per frame - best with elephant seals - permanent record made - distribution on beach easily determined - fly during peal haulout

Table 2. Schedule of counts made to monitor pinnipeds in the Channel Islands National Marine Sanctuary

<u>Dates</u>	<u>Target Species</u>	<u>Platform/Technique</u>
February 14-28	<u>Mirounga</u> SRI - V3 SCI - V3 ANI - V3 SBI - V3	SMI - G0, V3, V9
April 14-28	<u>Phoca</u> SRI - V3 SCI - V3 ANI - V3 SBI - V3	SMI - V3
May 25 - June 10	<u>Phoca</u> SRI - G0, V3 SCI - V3 ANI - V3 SBI - V3	SMI - G0, V3
July 15-30	<u>Zalophus/Callorhinus</u> <u>Arctocephalus, Eumetopias</u> SCI - V3 ANI - V3 SBI - V3, V9	SMI - G0 ⁺ , V3, V9 ⁺ SRI - V3

G0⁺ - ground counts at preselected haulouts

V3 - aerial, 35mm counts

V9 - aerial, 9" format counts

* This technique will be used at no additional cost in 1983, 1984, 1985 and 1986 due to a previous contract to SWFC.

Table 3. CINMS Pinniped Census Form

Subject	Code	Cols
1. Date	6 col (yr/mo/da)	1-6
2. Time: start	4 col (military)	7-10
3. end	4 col (military)	11-14
4. Island	3 col SMI ANI SRI SBI SCI	15-17
5. Beach	3 col BLM code	18-20
6. Survey platform	2 col G0 - ground count A3 - aerial, 35 mm count AV - aerial, visual count A9 - aerial, 9" found VV - vessel, visual	21-22
7. Field party leader	3 col - initials	23-25
8. Counts:		
<u>Zalophus</u> total	4 col counts	26-29
pup	3 col counts	30-32
<u>Callorhinus</u> total	4 col counts	33-36
pup	3 col counts	37-39
<u>Mirounga</u> total	4 col counts	40-43
pup	3 col counts	44-46
<u>Phoca</u> total	4 col counts	47-50
pup	3 col counts	51-53
<u>Arctocephalus</u> total	2 col counts	54-55
<u>Eumetopias</u> total	2 col counts	56-57
9. Wind speed	2 col (mph)	58-59
10. Wind direction	2 col (8 pts)	60-61
11. Cloud cover	1 col (codes) c: clear (0% clouds) s: scattered (1-50% clouds) b: broken (50-98% clouds) o: overcast (100% clouds)	62
12. Temperature	2 col (centigrade)	63-64
13. Tide	3 col (F3.1 meters)	65-67
14. Disturbance	2 col: (codes) P - people on beach V - vessel near beach D - dog on beach	68-69

Table 4. Distribution of pinnipeds by beach within the sanctuary. Asterisks indicate pupping occurs on that beach. Data are from 1975-1982 (Bonnel et al. 1980 and Stewart 1981, 1982).

Species	SMI	SRI	SCI	ANI	SBI
N. fur seal	102*, 111*				
N. elephant seal	110*, 119* 120*, 146* 147*, 151- 159*, 161, 171, 172				302-304 308, 310*, 311, 317, 322
Calif. sea lion	102*, 103, 110*-119*, 120, 151- 156, 161, 171*, 172	615, 621	641, 643 645, 646 648, 649	660, 670 680	302*, 303*, 304, 305 306, 307 308*, 309*, 310*, 311*, 312*, 313, 314, 317*, 318*, 322, 323, 324, 325*
Harbor seal	121, 122* 123, 130- 132*, 134* 142-144*, 145, 146*, 147*, 150*, 157*, 159*	611, 612*- 615*, 617- 619*, 621* 622, 624*- 626*	641*, 643, 645*, 647*, 649*, 651*, 653, 654*, 656*, 658*	660*, 670*, 680	306, 316*
Northern sea lion	110, 111				
Guadalupe fur seal	110, 111				

Observers:

Weather:

wind
cloud cover
tide height
temperature
disturbance

Field Party Leader:

Survey Platform:

Island	Beach (BLM Code)	Date	Time Start End	Species								Comments	
				<u>Zalophus</u>		<u>Mirounga</u>		<u>Phoca</u>		<u>Callorhinus</u>			Other
				pups	total	pups	total	pups	total	pups	total		

Figure 1. Pinniped census data form.

APPENDIX I.

SUMMARY OF BLM CODES USED IN PINNIPED
CENSUSES WITHIN THE CHANNEL ISLANDS NATIONAL PARK

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SUMMARY OF BLM CODES USED IN PINNIPED CENSUSES

The following list of figures should be used in referencing hauling sites within the Channel Islands National Park. These codes were developed by researchers from the University of California, Santa Cruz, for a contract on marine mammal distribution in southern California (1976-1978) to the Bureau of Land Management (BLM). It is only by using consistent location codes that an efficient reporting system can be developed and maintained.

List of Figures

Figure 1. Summary of BLM codes for San Miguel Island.

Figure 2. Summary of BLM codes for Santa Barbara Island.

Figure 3. Summary of BLM codes for Santa Rosa Island.

Figure 4. Summary of BLM codes for Santa Cruz Island.

Figure 5. Summary of BLM codes for Anacapa Island.

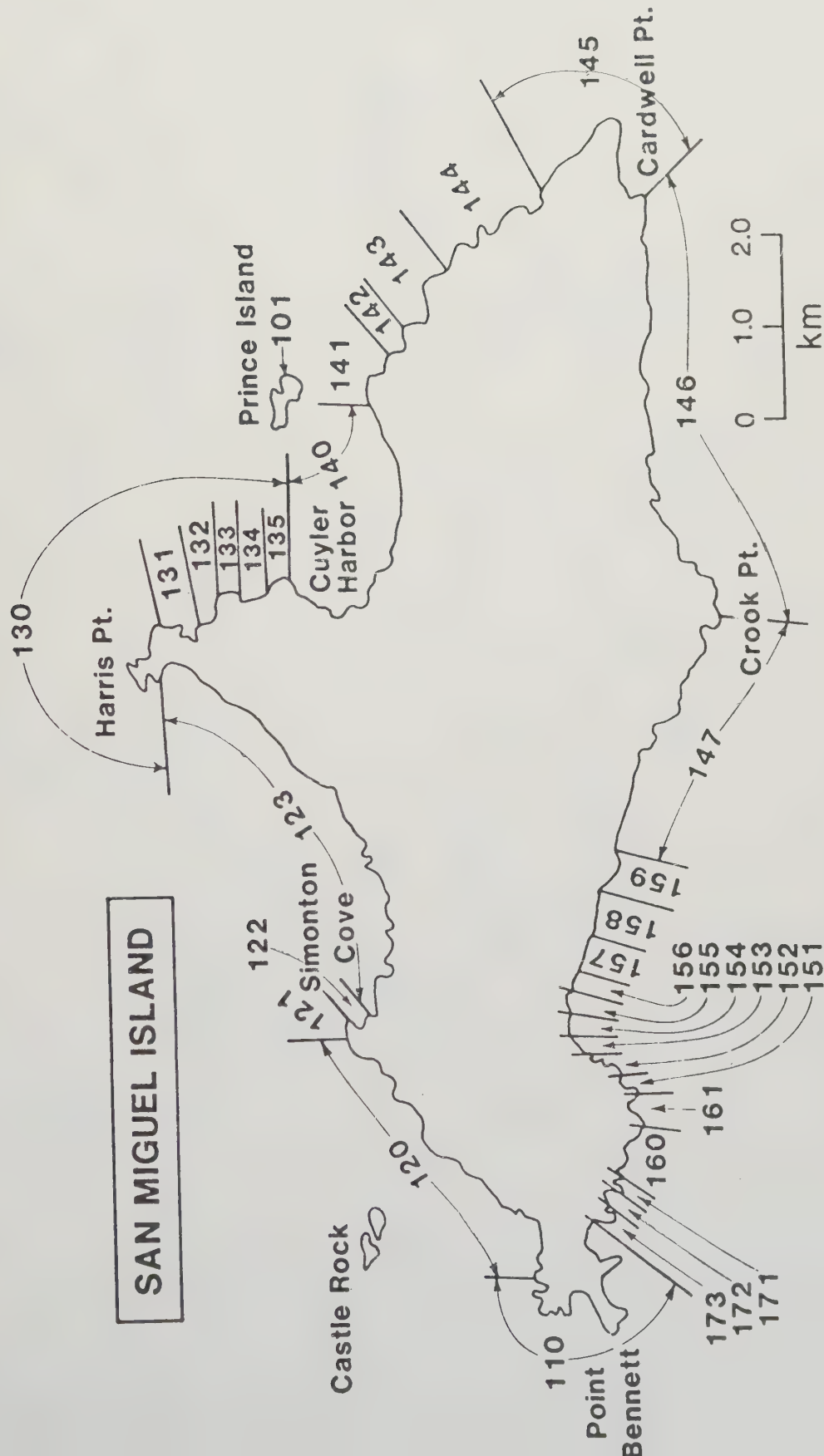


Figure 1. Summary of BLM codes for San Miguel Island.

SANTA BARBARA ISLAND

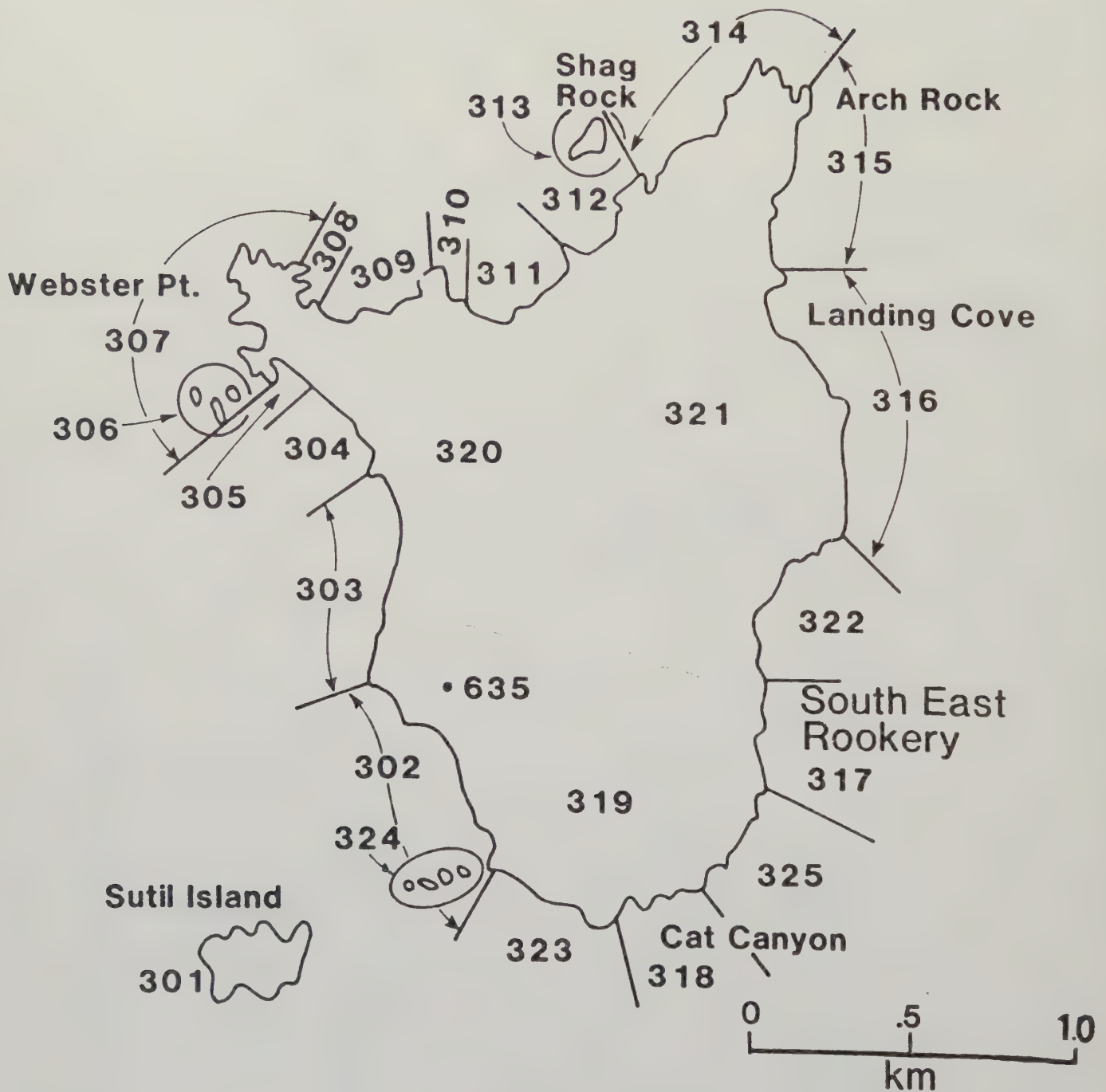


Figure 2. Summary of BLM codes for Santa Barbara Island.

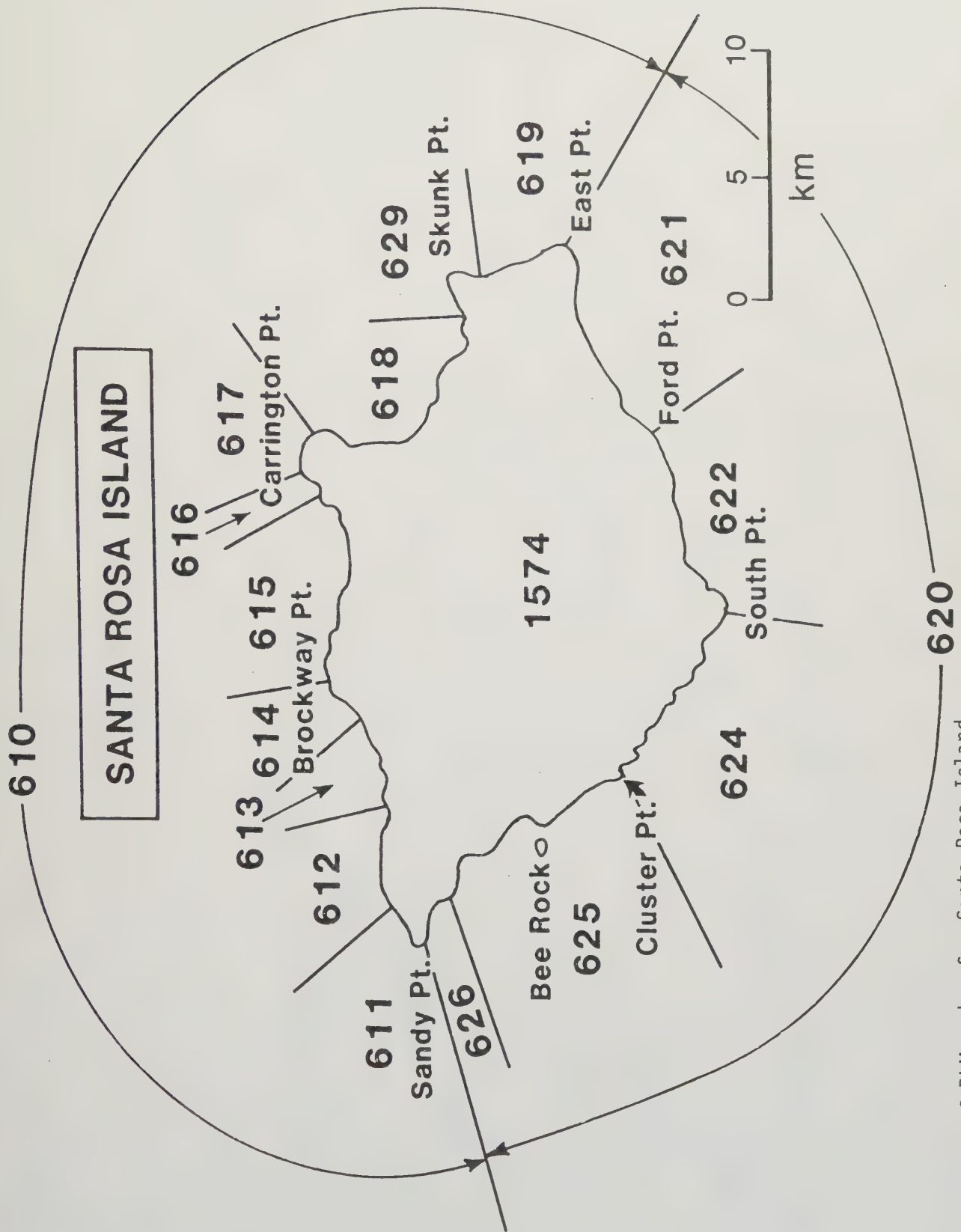


Figure 3. Summary of BLM codes for Santa Rosa Island.

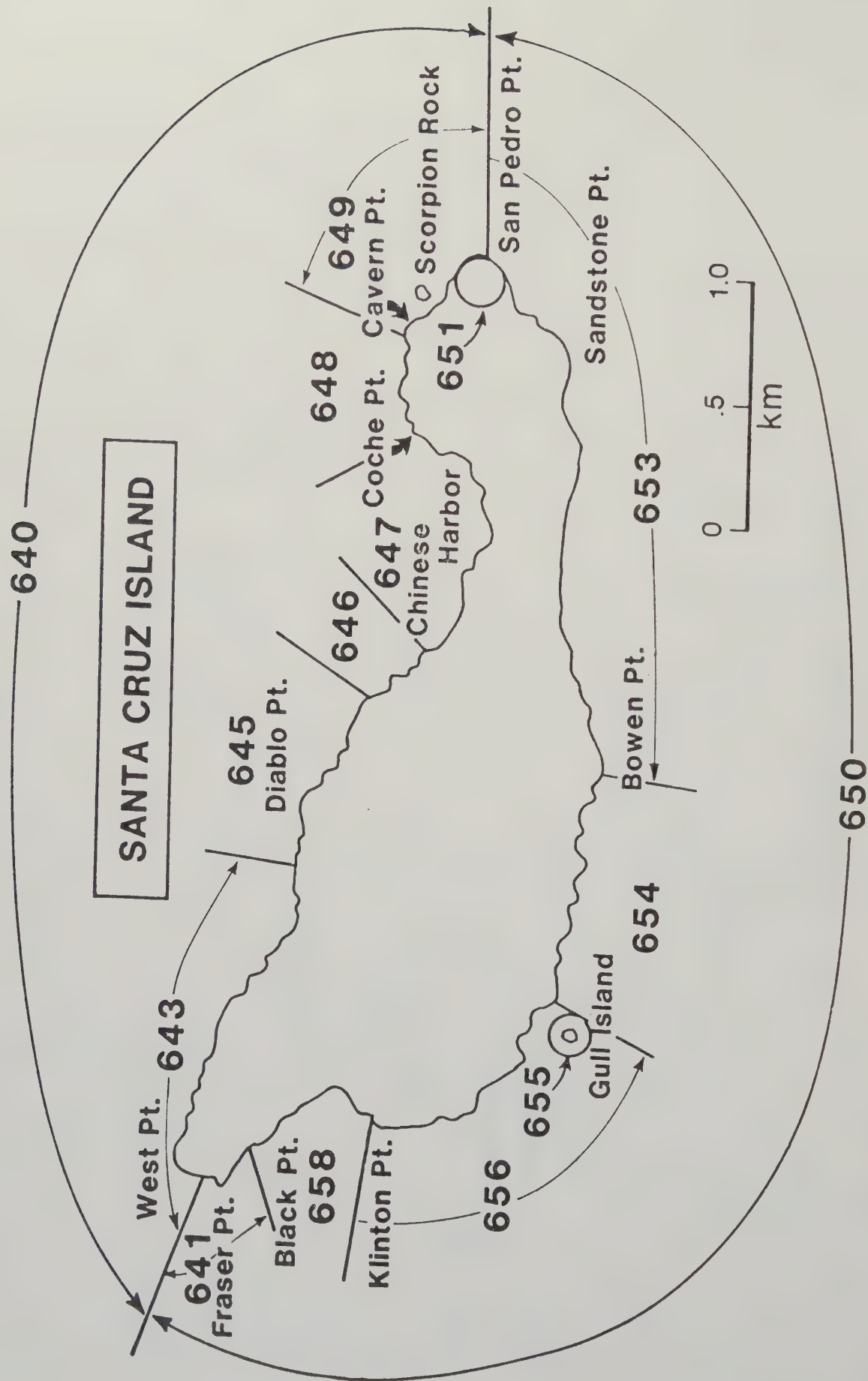


Figure 4. Summary of BLM codes for Santa Cruz Island.

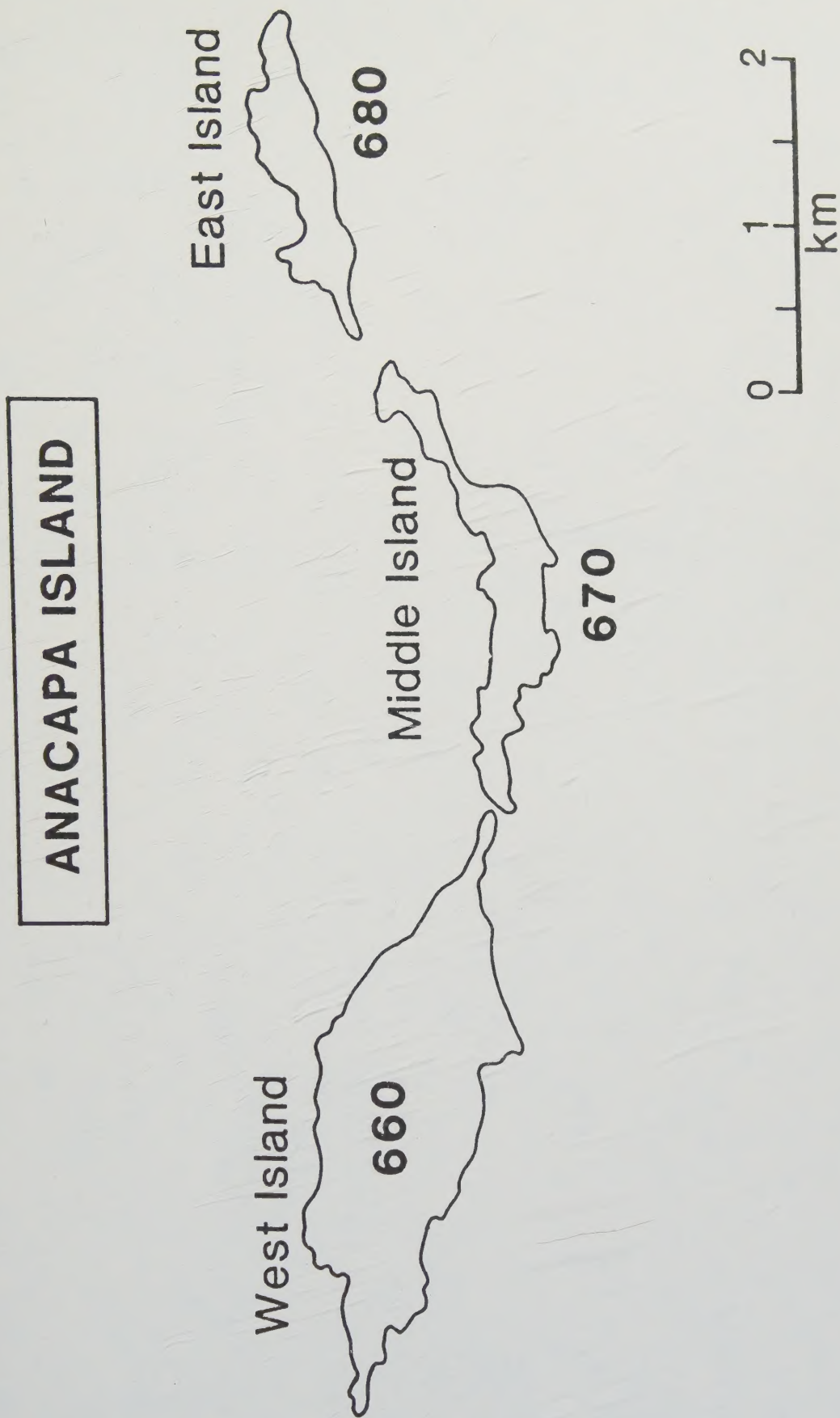


Figure 5. Summary of BLM codes for Anacapa Island.

